

What if we had a record crop and

An update on mechanical harvesting research

What if Florida had a record citrus crop and no one came to harvest it?

A thought like that can make your skin crawl. Yet a recent report written by Galen Brown, harvesting program administrator for the Florida Department of Citrus, indicates the harvesting labor force will be drastically reduced in coming years. And those labor reductions are expected to come in years when production records may be set year after year.

Brown's report said an estimated 42,600 production and harvesting workers were needed in Florida at the peak of the 1996-97 crop. "The workers were largely single young Mexican males who migrate each year," he wrote. "Surveys reveal that over 50 percent of these individuals are undocumented workers (illegally employed)."

The rub comes from the last two words in parenthesis – illegally employed. According to Brown's report: "The 1996 Illegal Immigration Reform and Immigrant Responsibility Act increased the enforcement efforts to prevent employment of illegal workers and the penalties on employers. There will be a continual decrease in the traditional labor force. This will force the adoption of harvesting systems requiring only 15,000-20,000 workers."

If Brown's report is right, the Florida citrus crop at some point will have to be harvested by a third to a half of the labor force that's traditionally been available.

The expected drastic reduction in available harvesting labor was one of the reasons the Department of Citrus initiated a new harvesting program in 1995. Another major force behind the new harvesting program's creation was the high cost of harvesting. By the mid-1990s, the average cost of getting a field box of oranges for processing off the tree and onto a 500-box roadside trailer had climbed to \$1.45. Costs ranged above and below that \$1.45 average. For some growers, total harvesting costs have exceeded total production costs.

Brown and industry advisory committees that give him direction want to drastically cut both harvesting costs and the number of laborers needed to harvest Florida's crop.

Virtually everyone concedes that fruit bound for fresh markets must continue to be harvested by hand. Consequently, a majority of the laborers available in the future may be needed just to harvest fresh fruit. Many think most of the 200 million boxes-plus of oranges bound for processing eventually will have to be harvested by machines requiring few laborers.

MORE MACHINES

Partly as a result of private industry initiative and partly as a result of the Department of Citrus' program, numerous mechanical harvesting devices have been tried out over the past few seasons. They have included trunk shakers, canopy shakers and devices with hundreds of "fingers" that are inserted into the canopy and pull fruit off. Several offer promise.

Brown is glad to see the different designs and thinks a variety of machines will be needed in Florida. "The industry is so diverse a contractor probably can't invest in just one harvesting system and do all the groves he has under contract," he said. "None of these can do everything except the hand picker. We're coming up with a wide range of choices on machines that will work."

Brown said groves differ vastly by tree variety, age, size, spacing, soil and shapes. Those are just a few of the variables that make it almost impossible for one machine to fit every grove. Jodie Whitney, a long-time mechanical harvesting researcher with the University of Florida's Institute of Food and Agricultural Sciences (IFAS), agreed that several different types of machines are called for. "The groves down south are much more uniform than what we had up north 25 years ago," he said. Yet many of those more northern groves with relatively wide spacing between trees remain, and their owners will be distraught if they aren't harvested every season.

NEW DEVELOPMENTS WITH CANOPY SHAKERS

Brown has been excited for a couple of years about the possibilities of a U.S. Department of Agriculture-designed canopy shaker that moves continuously down a hedgerow, shaking fruit from trees.

He thinks it has tremendous potential to drastically reduce harvesting costs and labor requirements.

His optimism was boosted this summer when Turner Foods Corp., which has about 19,000 acres of groves, advised him it plans to build a commercial harvester based on the USDA design. Turner Foods will contract with Florida and Michigan firms for the construction.

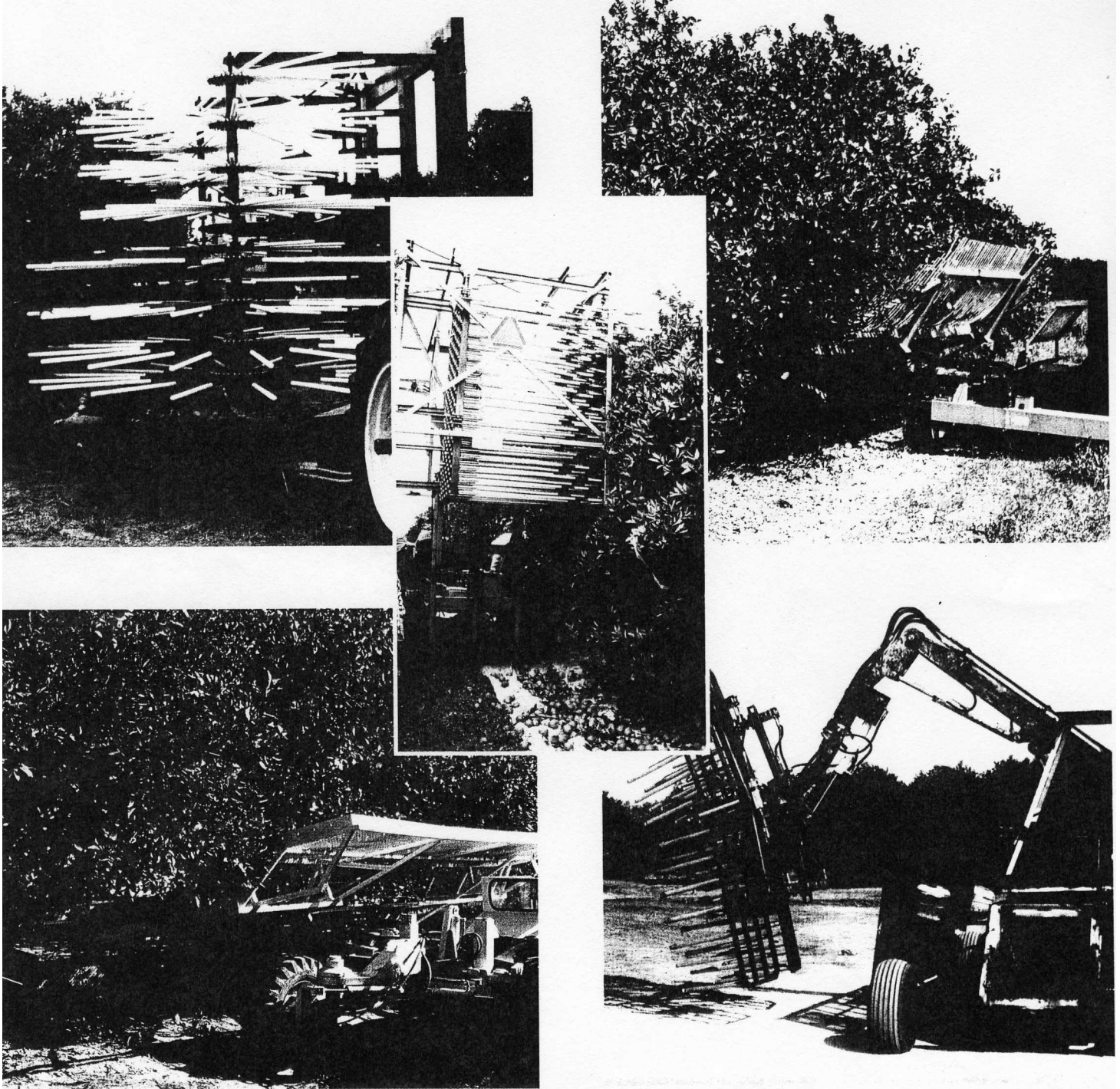
"This is the first indication that a grower in the citrus industry is going to take on the commercialization of a harvesting system," Brown said. He said Turner Foods believes the canopy shaker offers the best potential for effective mechanical harvesting when abscission chemicals aren't available (see accompanying update on abscission chemicals).

The USDA-designed canopy shaker has two large vertical posts with horizontal rods mounted on them. The rods continuously shake horizontally as the harvester moves down a row middle, rolling and shaking through tree after tree. Brown said the device requires that trees be hedged to create "a fruiting wall." The machine works best on densely-planted groves; he said a 10-foot by 20-foot planting with 217 trees per acre would be perfect. In an old-style, sparsely-planted grove "it's an absolute, unmitigated disaster."

"It's capacity is tremendous," Brown said of the canopy shaker when it's used in groves planted densely to create hedgerows. "This one gives us the greatest (potential) worker productivity and the lowest harvesting cost at roadside. Worker productivity may increase by 15 times and harvesting costs may decrease by 75 percent." Brown said to achieve those kinds of results day after day, the harvester must have access to an abundant supply of bulk trailers to receive the fruit at roadside. A lack of plenty of available trailers would leave machines sitting idle, ruining their efficiency.

Brown said he thinks the machine Turner Foods plans to build may be able to recover 90-95 percent of the fruit on the tree, even without abscission chemicals.

"Hopefully, Turner Foods will make a go of it," IFAS' Whitney said. "I think it has potential if we can get the trees a little better suited



Because Florida groves are so diverse, harvesting experts think a variety of machines will be necessary to mechanically harvest a significant portion of the state's citrus. Mechanical harvesters being tested include: Top left — a U.S. Department of Agriculture-designed canopy shaker; top right — Fruit Harvesters International's trunk shaker; bottom right — J&G Harvesting's Mongoose; bottom left — Compton Enterprises' trunk shaker; center — the Crunkelton canopy penetrator.

to the unit. I still have questions about what kind of fruit recovery they can get." He said his evaluations of the USDA machine last season showed it usually didn't remove more than 80 percent of oranges. But he added that growers may be willing to leave some fruit on their trees if fruit prices continue to be as low as they have been. He explained that a fast, inexpensive harvesting method might make up for leaving some fruit unharvested. Traditionally, growers hate to leave any fruit on trees; they refer to unharvested fruit derogatorily as "shiners."

Brown is also enthused about another canopy shaker – the Mongoose – built by J&G Harvesting in Arcadia. The operator of the Mongoose can move a boom arm to position four rectangular grids, each containing foliage-penetrating rods, on a quarter of a tree. A shaking motion is then applied to remove fruit. The Mongoose is positioned in the midst of four trees and shakes parts of each tree before moving on.

The fruit falls onto collecting surfaces and is conveyed away. Two to three workers on the ground follow the machine and pick fruit that is left over on the tree, as well as any that fell on the ground.

J&G Harvesting has reported it has tripled worker productivity, to 27 boxes per worker per hour, and saved 50 cents delivering fruit to roadside.

"It appears to be a very versatile system," Brown said. "It can handle old-style, inter-set and bedded groves. Most of the other systems require certain types of uniform groves."

Brown said if the Mongoose's projected savings materialize, "growers and contractors should be interested in using that system."

Despite his enthusiasm, he cautioned that the machine's required use of three or four workers doesn't provide enough labor savings to

make it effective when there's a severe labor shortage. "It's a system that may be used during a transition period (from hand harvesting to mechanical harvesting) that may exist for years."

Whitney said unlike the USDA's canopy shaker, the Mongoose has the advantage of being applicable to all shapes of trees. But he said the same design that enables it to be positioned for different types of trees "slows the operation down considerably... Can you get enough speed out of it to justify the amount of fruit you get?"

This year, the Department of Citrus will provide the Mongoose's builders with a development loan to construct two machines for tests.

TRUNK SHAKERS

Over the years, trunk shakers have been evaluated by IFAS and the DOC more than any other type of harvester. And trunk shakers developed and owned by Fruit Harvesters International (FHI) have performed the only large-scale commercial harvesting in Florida in recent years. FHI has harvested about 2,500 acres in a season – or less than half a percent of Florida's total citrus acreage.

The Department of Citrus will be a patron of trunk shaker research again this season. One of its cooperators will be Compton Enterprises of California, which has worked to improve its system over the past two seasons. The Compton system has suffered some mechanical breakdowns and other problems in the past. However, Brown said it has the potential to increase worker productivity more than four times and reduce roadside harvesting costs by about 50 percent.

The Compton shaker requires clear trunks up to at least 15 inches, trunks averaging less than nine inches in diameter and trees that are uniformly spaced at least 10 feet apart.

The department will also provide a small amount of funding to test a Yugoslavian company's piston-actuated trunk shaker on Florida orange trees.

Brown and Whitney both pointed out that many growers believe trunk shakers will kill or severely damage their trees. No long-term studies with modern trunk shakers – which move trees more than older versions – have been conducted to dispel those beliefs. Brown said tree decline is very unlikely. He said FHI has completed four years of trunk shaking and their customers don't see a problem.

PENETRATORS, ETC.

The department is also funding

additional research on the Crunkelton canopy penetrator which stops to make two insertions of rods into each tree. When the rods are withdrawn, small spring-loaded fingers pull individual pieces of fruit off the tree.

Brown said the Crunkelton penetrator "has quite a bit of flexibility." It can work in groves that are bedded or unbedded, hedged or unhedged. He said it has the potential to cut roadside harvesting costs by 50 cents a box and increase worker productivity four times. However, many improvements – including automation – are needed to achieve those potentials.

No additional funding is planned this year for a pick, drop and mechanized pickup system that Brown thinks could be used immediately if labor shortages hit. The system, developed by Agricultural Machines, Inc. of Avon Park, has workers pick fruit and drop it onto the ground. A machine then comes along to pick the fruit up from under the canopy. Brown said picker productivity is doubled and harvesting costs at roadside are reduced at least 20 percent. Those results are sufficient to make the machine a viable option during a slight labor shortage, but not for the full-blown shortage many foresee several years out.

The system is best suited to flat land with gentle beds and can probably be used on about half of Florida's processed orange acreage. It doesn't work well in deeply bedded groves such as those found in most southern and coastal areas.

EVERYONE'S HELP NEEDED

Brown said all of the harvesting systems mentioned have the potential to cut grower costs and increase labor productivity. "I think they're all viable," he said. "It's just a matter of getting the machines to hold up for the long harvesting season."

He said processors and growers will play a key role in the potential success of mechanical harvesting systems. He explained that processors must provide enough bulk trailers in a short time to contain all the fruit that is harvested rapidly; if they don't, harvesting machines will sit idle. Prior to planting new groves of fruit for processing, growers must consider what planting patterns and other grove characteristics are best suited to efficient forms of mechanical harvesting. The best producing groves in the state will have a tough time being profitable if the fruit can't be harvested cost effectively.



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